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In re Application of:	
John David Porter et al.	
Serial No.: 09/592,683 (09/592683)	Group Art Unit: 2799
Filed: June 12, 2000	Examiner: Not assigned

For: CONTROL SIGNALLING AND DYNAMIC CHANNEL ALLOCATION IN A WIRELESS NETWORK

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CLAIM FOR PRIORITY

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Under the provisions of 35 U.S.C. § 119, Applicants hereby claim the benefit of the filing date of British Patent Application No. 9913697.0, filed June 11, 1999, for the above-identified U.S. patent application.

In support of Applicants' claim for priority, filed herewith is one certified copy of the above.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P.

By: Ernest F Chapman
Reg. No. 25,961

Date: October 30, 2000

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1.	Your reference	ABC/NJW
2.	Patent application number *(The Patent Office will fill in this part)*	9913697.0
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	Adaptive Broadband Ltd. Block C1, First Floor Westbrook Centre Milton Road Cambridge CB4 1YQ
	Patents ADP number *(if you know it)*	7606726001
	If the applicant is a corporate body, give the country/state of its incorporation	A UK company
4.	Title of the invention	Dynamic Channel Allocation in a Wireless Network
5.	Name of your agent *(if you have one)*	A. A. THORNTON & CO.
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Northumberland House, 303 - 306 High Holborn, London WC1V 7LE
	Patents ADP number *(if you know it)*	75001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
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Continuation sheets of this form	
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Claim(s)	7
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Priority documents	-
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
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Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent on the basis of this application.

Signature
A. A. THORNTON & CO.

Date
11 June 1999

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr. Andrew B. Crawford - 0171 405 4044

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Duplicate

Dynamic Channel Allocation in a Wireless Network

The present invention relates to a method and system for providing dynamic channel allocation in a wireless communications network during continuous network operation.

More particularly, the present invention relates to a method and system for providing dynamic channel allocation in a wireless network arranged in a cellular configuration, and wherein transmissions in each cell are monitored at various positions throughout the cell to collect information on local radio conditions in each cell, the information then being used to dynamically allocate one of a limited number of wireless channels for data communications within the cell.

The proliferation of data communications throughout recent years has caused great demand for high bandwidth reliable data networks. Furthermore, many cost advantages are to be made in deploying wireless data networks, as there is then no need for the great expense of laying cables, wiring buildings, etc., and a more flexible network service may be provided. There is however a single major disadvantage of using a wireless data network instead of a wired network in that the wireless channels over which the data are transmitted can be prone to radio interference from a variety of sources. In order therefore to provide for reliable data communications some mechanism must be provided which allows the network to survive the presence of an interfering signal.

The present invention provides a method and system for providing dynamic allocation of wireless channels during continued network operation which allows a network to overcome any interference. By providing an intelligent initial assignment of channels for use within the network, and by continuously monitoring the assigned channels' performance throughout the coverage area, the method and system of the present invention allow for alternative channels to be allocated to those network nodes suffering from interference on their particular

current-assigned channels, thus ensuring that reliable wireless data communications can be maintained across the whole network coverage area.

According to one aspect of the present invention, there is provided a method of dynamic channel allocation for use in a wireless communications network arranged in a cellular configuration, each cell of said network being divided into one or more regions, each region containing a fixed base station and one or more fixed remote subscriber terminals, the network having a limited number of channels available for communication, said method comprising the steps of:

a) allocating one of the available channels to each region in a predetermined manner;

b) monitoring at least the allocated channel in each region to detect at least the presence of any interference; and

c) re-allocating a different channel to at least those regions in which interference was detected at step b);

wherein steps b) and c) are continuously repeated in order whereby channels may be dynamically re-allocated to regions during continuous network operation.

The monitoring step may further include the step of: further monitoring a plurality of the available channels in addition to the allocated channel in each region to detect at least the presence of any interference on each of the plurality of the available channels. In such a case, the re-allocating step c) re-allocates one of the plurality of the available channels on which no interference was further monitored as said different channel.

The allocating step a) may further comprise the steps of: assignment by a network control server of one of the available channels to each region in the pre-determined manner; and communicating the channel assignments to at least the fixed base station in each region from the network control server over a first signalling channel. Additionally, the channel assignments may also be

communicated direct to the subscriber terminals.

The monitoring step b) may further comprise the steps of : generating channel metrics from the subsequent transmissions in each region, a separate set of channel metrics being generated by each of the remote subscriber terminals and by the fixed base station in each region; and communicating the channel metrics to the network control server over a second signalling channel. The first and second channels may be ATM channels such as VPI/VCI pairs.

The fixed base stations in each cell may locally re-allocate alternative channels to the regions in the cell, instead of the network server. Additionally, it will also be possible to allow the fixed base stations to act in a distributed manner to perform global network frequency re-allocation.

According to the present invention, there is also provided a system for dynamic channel allocation for use in a wireless communications network arranged in a cellular configuration, each cell of said network being divided into one or more regions, each region containing a fixed base station and one or more fixed remote subscriber terminals, the network having a limited number of channels available for communication, said system comprising:

a) channel allocation means for allocating one of the available channel to each region in a predetermined manner;

b) monitoring means for monitoring at least the allocated channel in each region to detect at least the presence of any interference; and

c) channel re-allocation means for re-allocating a different one of the available channels to at least those regions in which interference was detected by said monitoring means;

wherein said monitoring means and said channel re-allocation means each repeat their operations in order whereby channels may be dynamically re-allocated to regions during continuous network operation.

The monitoring means may further include second monitoring means

for further monitoring a plurality of the available channels in addition to the allocated channel in each region to detect at least the presence of any interference on each of the plurality of the available channels.

In such a case, the channel re-allocation means re-allocate one of the plurality of the available channels on which no interference was detected by the second monitoring means as said different channel.

The channel allocation means may further comprise means for assigning each region one of the available channels in the pre-determined manner, said means forming part of a network control server; and means for communicating the channel assignments to at least the fixed base station in each region from the network control server over a first signalling channel. Additionally, the channel assignments may be communicated direct to the subscriber terminals.

The monitoring means may further include: generation means for generating channel metrics from the subsequent transmissions in each region, a separate set of said generation means being included in each of the remote subscriber terminals and in the fixed base station in each region; and communications means for communicating the channel metrics to the network control server over a second signalling channel. The first and second signalling channels may be ATM VPI/VCI pairs.

The channel re-allocation means may form part of the network control server, and may execute either local or global re-colouring schemes.

Alternatively, the channel re-allocation means may form part of each fixed base station, whereby channel re-allocation may be performed locally for a particular cell by the base stations located in each cell. Moreover, it may be possible for the individual channel re-allocation means in each base station to act together in a distributed processing manner to perform global channel re-allocation throughout the entire network.

In both the method and the system of the present invention, the

available channels are allocated to the regions in such a manner that a particular region is allocated a different one of the available channels to those available channels allocated to each of the surrounding adjacent regions to the particular region.

Furthermore, each of the available channels comprises a specific frequency band together with a specific polarisation. The polarisation may be either linear, in which case it may be either horizontal or vertical, or circular, in which case it may be either left-handed or right -handed.

Moreover, in the case of the cell being divided into more than one region, each region of the cell is made to be of substantially equal area, and each of the respective fixed base stations for each region are substantially co-located.

It is an advantage of the present invention that when providing coverage to a metropolitan area comprised of many cells, spectrum re-use is highly efficient.

There is a further advantage that subscriber terminals directly measure channel metrics and report them back to the control server, providing complete information about the spectral activity occurring within the entire coverage area.

Furthermore, because the control server has access to all base stations within a metropolitan area, it has the ability to execute either a globally optimal dynamic recoloring scheme, or a locally optimal scheme that is more computationally tractable.

Further features and advantages of the present invention will become apparent from the following detailed description of a particularly preferred embodiment thereof, presented by way of example only, and by reference to the accompanying drawings, in which:-

Figure 1 illustrates an example set of available channels for network operation;

Figure 2 demonstrates initial channel allocations used in one cell

within the present invention;

Figure 3 shows an example initial channel allocation using four channels over multiple cells, which may be used in the present invention;

Figure 4 shows an example initial channel allocation using six channels over multiple cells, which may be used in the present invention;

Figure 5 illustrates a tiling of multiple cells using four channels to cover a large area;

Figure 6 illustrates a tiling of multiple cells using six channels to cover a large area;

Figure 7 shows a polar plot of the radiation pattern in the horizontal plane of an example antenna used within the method and system of the present invention; and

Figure 8 shows a polar plot of the radiation pattern in the vertical plane of an example antenna used within the method and system of the present invention.

Within the drawings, the fill patterns used in each region of Figures 2 to 6 demonstrate the example channels and polarisations which can be used in each region upon an initial frequency assignment. The fill patterns depicted correspond to those used in Figure 1, such that it is possible to determine from the fill pattern which channel is used in each region and whether the polarisation is horizontal or vertical.

A particularly preferred embodiment of the present invention will now be described, in which the present invention is used in a wireless network system to provide wireless internet access over a large metropolitan area. It is to be understood that the following description is to be considered as a non-limiting example, and that the method and system of the present invention may find application in any wireless data communications network.

In the network system of the present embodiment, the network coverage area is divided into cells, each cell having a central fixed base station

referred to herein as an access point, and one or more remote subscriber terminals. The subscriber terminals are at fixed locations. This allows the use of highly directional antennas at the cell site and at the subscriber site. The system uses the United States UNII band, which provides more total available bandwidth than this network requires to provide service to a metropolitan area. Because the band of operation is unlicensed, the network must have some mechanism for surviving the presence of an interfering signal. The extra bandwidth provides reserve channels that can be called into use in the presence of interference. The channelization of the UNII band used by this network is shown in Figure 1.

In order to increase the re-use of the available spectrum, the system takes advantage of vertical and horizontal polarization of antennas. By combining this scheme with intelligent assignment of frequencies within the network, the number of available channels can effectively be doubled.

The network system in which the present invention is employed takes advantage of the highly directional radiation pattern of the antennas located at both the subscriber terminal and the access point to re-use frequencies among multiple sectors of a single cell. It also uses the ability of the subscriber terminals to measure channel statistics throughout the coverage area in order to maintain a dynamically changing channel allocation that provides the best possible network performance in the presence of non-stationary interfering signals.

The wireless network is deployed over the network coverage area in a cellular hexagonal grid pattern, as shown in Figures 5 and 6. Since the actual coverage pattern of each cell is circular, the deployment of cells provides some overlap among adjacent cells. This overlap provides for some dynamic load balancing of the network.

In the present particularly preferred embodiment each cell consists of six sectors, with one access point per sector. An access point is capable of acting as a complete cell base station, providing service to up to 256 subscriber terminals, for example. However, to increase network density it is paired with a

directional antenna to cover only a 60 degree horizontal beamwidth, or 1/6th of the total coverage area of the cell. Each access point uses time division multiple access to distribute access to the wireless medium among the subscriber terminals it serves. Because the transmit activity of each access point will be statistically uncorrelated with that of the other access points, it must be assumed that, unless adequate signal attenuation exists between access points, multiple access points of a single cell sharing the same frequency will cause co-channel interference to each other. The operation of such a network and access scheme is described in detail in our co-pending British Patent Application No. 9907481.7.

There are several key issues of the network equipment and the wireless network deployment that affect the channel allocation among the sectors of a cell. Of particular relevance is the co-channel interference tolerance of the radio equipment (the signal to interference plus noise ratio required for acceptable data error rate). Furthermore the tolerance of the radio equipment to an adjacent channel interferer must also be taken into account, as must the radiation pattern of the access point and subscriber terminal antennas, as well as the separation in frequency of the channels used within a single cell. Finally, the coverage area overlap of adjacent cells is also of importance.

When assigning the frequencies to the sectors within a cell, the pattern of the access point antenna becomes the most critical consideration. Figures 7 and 8 show the respective horizontal and vertical radiation patterns of an example access point antenna. From theses plots it is easily apparent that the example antenna employed is highly directional, with a -3dB beamwidth of approximately 60° in the horizontal plane, and of less than 10° in the vertical plane. Frequency re-use in different cells and sectors within the network thus becomes a possibility due to the high spatial separation of radiation patterns possible with such an antenna. Additional isolation between access points may also be provided using the vertical radiation pattern of the access point antenna. By mounting the access point antennas at slightly different heights, the highly

directional vertical pattern provides additional signal power isolation to protect against network self-interference.

When deploying the network within a metropolitan area, self-interference between cells must be considered. There are several network self-interference cases to consider when verifying the usability of a particular initial channel allocation scheme. They are:

1. Access points causing co-channel interference in the receiver of an adjacent cell access point
2. Access points causing co-channel interference in the receiver of a subscriber terminal which is actually registered with an adjacent access point
3. A subscriber which is in the coverage area of one access point causing co-channel interference in the receiver of an adjacent access point.
4. A subscriber terminal causing co-channel interference in the receiver of a subscriber terminal which is located in an adjacent coverage area.
5. Co channel interference from the sector of the adjacent cell in 90 degree opposition.

Having regard to the above five points, two example initial channel allocation schemes will now be described. The two schemes presented are by way of example only, and other such schemes will be apparent to the man skilled in the art which provide a comparable performance to the schemes detailed herein, and which may be used with the present invention.

The first scheme to be described uses two frequency bands per cell, with each band having either horizontal or vertical polarisation to give effectively four different channels. The use of horizontal or vertical polarisation effectively doubles the number of available channels. Figure 2(a) illustrates such four channel allocation within a cell. From Figure 2(a) it will be seen that two sectors, whose

main beams have an angular separation of 120 degrees, are assigned the same frequency and polarization. The horizontal and vertical radiation patterns of the antenna and the signal attenuation of free space are used to provide the required isolation between the sector coverage areas. In particular, the antennas of the two access points sharing the same frequency and polarization are mounted at heights differing by several centimeters, in order to provide additional isolation due to the vertical angular separation. It is then necessary to make the third sector sharing this frequency of opposite polarization, in order to provide isolation between cells when they are deployed in a multi-cell network. Figure 3 then illustrates the case when two cells sharing the same frequencies are adjacent to each other. In such a case they are arranged such that their adjacent sectors are of opposite polarizations, thus providing an additional 20 dB of isolation between them. A "super-tile" of four cells may be arranged together in this manner such that no sector has an identical frequency and polarisation allocation as any adjacent sector. Such "super-tiles" of four cells may then be combined to cover as large an area as necessary, as shown in Figure 5.

An initial frequency allocation using three frequency bands per cell will now be described, with reference to Figures 2, 4, and 6.

The two-frequency coloring scheme provides marginal isolation in some cases. To improve isolation, an additional frequency is used per cell, as shown in Figure 2(b). In this scheme, two sectors of a cell share the same frequency. They are in 180 degree opposition, and are of opposite polarization, providing an additional 20 dB of isolation above the free space loss and antenna pattern loss. Adjacent cells are arranged such that overlapping coverage areas are assigned different frequencies, as shown in Figure 4. Again, a four cell "super-tile" may be created which ensures that no single sector is adjacent to another sector with an identical frequency and polarisation channel assignment. The three-frequency per cell scheme typically improves upon the two-frequency per cell scheme by an increased polarisation loss and increased spatial separation between

two sectors which are assigned the same channel. The super-tiles may be combined to cover as large an area as necessary, as shown in Figure 6.

The above discussion has centred on the initial frequency assignment within the coverage area. The present invention provides for dynamic channel assignment during continuous network operation, and hence various aspects of the dynamic channel allocation method and system will now be discussed further.

The purpose of dynamic frequency colouring is to allow the network to autonomously adapt to changing channel conditions while the network is in active operation. The network needs to monitor performance aspects of the available channels, either directly or indirectly, in order to know which new frequency assignments to make.

In the particularly preferred embodiment, the wireless network will be deployed in a manner that atmospheric and thermal noise are not significant sources of performance degradation. Rather, man-made interferers, namely periodic pulse noise from electrical equipment, and other intentional radiators operating in our network's band of operation, including elements of the network itself, are the most serious threats to performance.

The network gets incomplete information if it only monitors the wireless channels at the access points. In order for the network controller (referred to herein as the control server) to have complete knowledge of the channel conditions throughout the network, it is necessary for each of the subscriber terminals to also sense the channels and report metrics back to the control server via a low bandwidth signalling channel. The control server will then collect the information into an aggregate database and execute the frequency re-assignment. The frequency re-assignment may be algorithmically based.

Various channel metrics may be collected at each subscriber terminal and used with the method and system of the present invention. The particularly preferred embodiment described herein collects and uses the following.

The first metric to be collected is the Received Signal Strength (RSSI). This is measured using a peak-driven digital AGC block that operates within the modem of each subscriber terminal/access point. This gives a coarse measure of total power present on the channel, to within 10 dB, regardless of its source.

The next metric is the Signal to Noise Ratio of the access point downstream transmissions to the subscriber terminals. This is found using an average of the correlation strength from past downstream bursts.

The final metric is the unrecoverable channel distortion. This is calculated using an average of the mean square error output of a decision feedback equalizer provided at each subscriber terminal and access point and used to remove inter-symbol interference (ISI) from the received data caused by the limited channel bandwidth. The ISI that can be removed will eventually cease to contribute to the magnitude of the channel equalizer error. Since the channel is stationary over relatively long time periods (relative to the training time of the equalizer), the long-term average is a valid metric to report.

As the network of the particularly preferred embodiment operates in a broadcast manner, downstream bursts broadcast from the access point are always available to be demodulated by each subscriber terminal. There is thus guaranteed network traffic available for the subscriber terminal to use in updating its channel metrics. Note that all three metrics may be made available for the operational frequency of the subscriber terminal's access point, and also for any other frequencies that have active network traffic and are of sufficient signal strength to be monitored by the subscriber terminal. Only the RSSI can be measured for all other channels being monitored on which there is no network traffic.

In order to allow the metrics to be communicated to the access points, the wireless access network provides ATM style network operation. A separate VPI/VCI pair is used for each data traffic stream sent to and from a

particular subscriber terminal. An additional VPI/VCI pair is used for network-wide signalling between the subscriber terminals and the base station control server. A separate VPI/VCI pair is then used exclusively for reporting the channel metrics and sending dynamic channel assignment information between access points and subscriber terminals. The subscriber terminals therefore all report back their measured statistics to the control server via this wireless network signaling virtual path/virtual circuit. Contained within the message are the metrics and an access point identifier, which gives indication as to the geographic location of the subscriber terminal doing the channel monitoring. The metrics fed back from all of the subscriber terminals that share a single access point are all weighted equally and averaged.

Because the control server aggregates the reported metrics, it has the freedom to execute whatever frequency assignment scheme is most appropriate. The control server may execute a globally optimal channel recolouring scheme, but such a network-wide dynamic channel allocation problem is an np-complete problem that must use iterative methods to arrive at an acceptable coloring of the network. It is therefore also possible for each cell base station to perform a locally optimal dynamic frequency allocation, which will allow the network to stabilize and perform at an acceptable level, with much lower implementation complexity than a globally managed frequency allocation scheme. Here, a locally managed channel allocation algorithm which does not yield a globally optimal frequency allocation can still provide satisfactory network performance. To implement such a local scheme, each subscriber terminal and access point within a cell periodically monitors all available channels for operation, and accumulates long term average metrics. The assumption is made that, by monitoring all channels, subscriber terminals will detect traffic originating in adjacent cells which will interfere. Each subscriber terminal reports the collected metrics back to the access point in the manner described above, the access point then choosing its new frequency of operation based only on the metrics reported within its cell.

The present invention also provides a number of further features and advantages. For example, subscriber terminals can be commanded into monitor mode, in which they briefly scan all candidate channels, accumulate metrics, report them back to the control server, then return to normal operation.

Furthermore, the subscriber terminals may auto-sense the frequency of operation of their base stations upon power up, and hence need no a priori knowledge of the network frequency allocation nor of their own geographic position with respect to cells using other frequencies.

Furthermore, those subscriber terminals that are located at the cell overlap areas can be automatically switched among access points in order to improve the balance of network traffic loading among access points, the switching occurring by virtue of the dynamic frequency allocation.

In addition, the system design of the present particularly preferred embodiment takes maximal advantage of the radiation pattern of the array antennas located at the subscriber terminal and the access point.

Moreover, each subscriber terminal may have the ability to monitor other channels during idle periods, making it possible to gather channel metrics without wasting any network bandwidth. Furthermore, subscriber terminals can also be commanded to monitor all other channels at regular intervals, giving a fixed and known sample distribution to the channel metrics. The ability to monitor the channels using the subscriber terminals allows the network to gather spatial information as well. It should therefore be possible to determine interferer location and velocity.

Finally, dynamic channel allocation may be performed either globally for the whole network, or locally for a particular cell, or group of cells. Whichever scheme is adopted, it will be understood that the re-allocation can be performed centrally by the network control server, or alternatively by the fixed base stations operating in a distributed manner.

CLAIMS:

1. A method of dynamic channel allocation for use in a wireless communications network arranged in a cellular configuration, each cell of said network being divided into one or more regions, each region containing a fixed base station and one or more fixed remote subscriber terminals, the network having a limited number of channels available for communication, said method comprising the steps of:

a) allocating one of the available channels to each region in a predetermined manner;

b) monitoring at least the allocated channel in each region to detect at least the presence of any interference; and

c) re-allocating a different channel to at least those regions in which interference was detected at step b);

wherein steps b) and c) are continuously repeated in order whereby channels may be dynamically re-allocated to regions during continuous network operation.

2. A method according to claim 1, wherein the monitoring step b) further includes the step of further monitoring a plurality of the available channels in addition to the allocated channel in each region to detect at least the presence of any interference on each of the plurality of the available channels.

3. A method according to claim 2, wherein the re-allocating step c) re-allocates one of the plurality of the available channels on which no interference was further monitored as said different channel.

4. A method according to any of the preceding claims, wherein the available channels are allocated to the regions at steps a) and c) in such a manner

that a particular region is allocated a different one of the available channels to those available channels allocated to each of the surrounding adjacent regions to said particular region.

5. A method according to any of the preceding claims, wherein each of the available channels comprises a specific centre frequency and bandwidth, and/or specific polarisation.

6. A method according to claim 5, wherein the polarisation may be linear or circular polarisation.

7. A method according to claim 7, wherein where linear polarisation is used, the polarisation may be either horizontal or vertical, and where circular polarisation is used, the polarisation may be either clockwise or counter-clockwise.

8. A method according to any of the preceding claims wherein when a cell is divided into more than one region, each region of the cell is of substantially equal area, and each of the respective fixed base stations for each region are substantially co-located, whereby each region is substantially in the shape of a sector of a circle.

9. A method according to any of the preceding claims, wherein each cell is divided into six regions, the respective fixed base stations of each region being substantially co-located in substantially the centre of the cell, whereby each region is substantially in the shape of a sector of a circle of 60° arc.

10. A method according to any of the preceding claims, wherein the allocating step a) comprises the steps of:-

a) assigning each region one of the available channels in the predetermined manner by a network control server; and

b) communicating the channel assignments to at least the fixed base station in each region from the network control server over a first signalling channel.

11. A method according to any of the preceding claims, wherein the monitoring step b) further includes the steps of:

a) generating metrics from the subsequent transmissions in each region, a separate set of channel metrics being generated by each of the remote subscriber terminals and by the fixed base station in each region; and

b) communicating the channel metrics to the network control server over a second signalling channel.

12. A method according to any of claims 10 or 11, wherein said first and second signalling channels are each ATM channels.

13. A method according to any of the preceding claims wherein a different channel is re-allocated to at least one region in every cell in the network.

14. A method according to claims 1 to 12, wherein a different channel is re-allocated to at least one region in a particular cell in the network.

15. A method according to claims 13 or 14 wherein the re-allocation step is performed centrally by the network control server.

16. A method according to claims 13 or 14 wherein the re-allocation step is performed by at least one of the fixed base stations, whereby said step may

be performed in a distributed manner.

17. A method according to any of claims 11 to 16, wherein the re-allocation step is performed in response to the collected channel metrics.

18. A system for dynamic channel allocation for use in a wireless communications network arranged in a cellular configuration, each cell of said network being divided into one or more regions, each region containing a fixed base station and one or more fixed remote subscriber terminals, the network having a limited number of channels available for communication, said system comprising:

a) channel allocation means for allocating one of the available channel to each region in a predetermined manner;

b) monitoring means for monitoring at least the allocated channel in each region to detect at least the presence of any interference; and

c) channel re-allocation means for re-allocating a different one of the available channels to at least those regions in which interference was detected by said monitoring means;

wherein said monitoring means and said channel re-allocation means each repeat their operations in order whereby channels may be dynamically re-allocated to regions during continuous network operation.

19. A system according to claim 18, wherein the monitoring means further include second monitoring means for further monitoring a plurality of the available channels in addition to the allocated channel in each region to detect at least the presence of any interference on each of the plurality of the available channels.

20. A system according to claim 19, wherein the channel re-allocation means re-allocate one of the plurality of the available channels on which no interference was detected by the second monitoring means as said different channel.

21. A system according to any of claims 18 to 20, wherein said channel allocation means and said channel re-allocation means each allocate the available channels to the regions in such a manner that a particular one of the regions is allocated a different one of the available channels to those available channels allocated to each of the surrounding adjacent regions to said particular region.

22. A system according to any of claims 18 to 21, wherein each of the available channels comprises a specific centre frequency and bandwidth and a specific polarisation.

23. A system according to claim 22, wherein the polarisation may be linear or circular polarisation.

24. A system according to claim 23, wherein where linear polarisation is used, the polarisation may be either horizontal or vertical, and where circular polarisation is used, the polarisation may be either clockwise or counter-clockwise.

25. A system according to any of claims 18 to 24, wherein when a cell is divided into more than one region, each region of the cell is of substantially equal area, and each of the respective fixed base stations for each region are substantially co-located whereby each region is substantially in the shape of a sector of a circle.

26. A system according to any of claims 18 to 25, wherein each cell is divided into six regions, the respective fixed base stations of each region being substantially co-located in substantially the centre of the cell, whereby each region is substantially in the shape of a sector of a circle of 60° arc.

27. A system according to any of claims 18 to 26, wherein the channel allocation means further comprise:

a) means for assigning each region one of the available channels in the predetermined manner, said means forming part of a network control server; and

b) means for communicating the channel assignments to at least the fixed base station in each region from the network control server over a first signalling channel.

28. A system according to any of claims 18 to 27, wherein the monitoring means further include:

a) generation means for generating channel metrics from the subsequent transmissions in each region, a separate set of said generation means being included in each of the remote subscriber terminals and in the fixed base station in each region; and

b) communications means for communicating the channel metrics to the network control server over a second signalling channel;

29. A system according to claims 27 or 28, wherein said first and second signalling channels are each ATM channels.

30. A system according to any of claims 18 to 29, wherein said channel

re-allocation means re-allocates a different channel to at least one region in every cell in the network.

31. A system according to any of claims 18 to 29 wherein said channel re-allocation means re-allocates a different channel to at least one region in a particular cell in the network.

32. A system according to claims 30 or 31, wherein said channel re-allocation means form part of the network control server.

33. A system according to claims 30 or 31, wherein a separate channel re-allocation means forms part of each fixed base station, whereby channel re-allocation may be performed in a distributed manner.

34. A system according to any of claims 28 to 33, wherein said channel re-allocation means re-allocates different channels to the regions in response to the collected channel metrics.

35. A method as substantially hereinbefore described and with reference to the accompanying drawings.

36. A system as substantially hereinbefore described and with reference to the accompanying drawings.

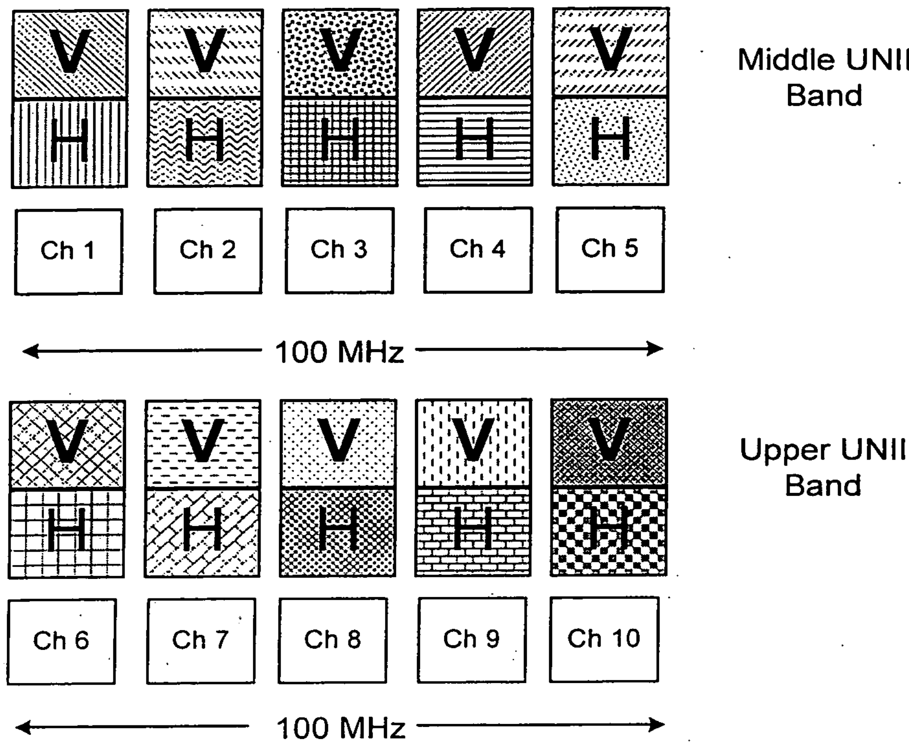

Figure 1

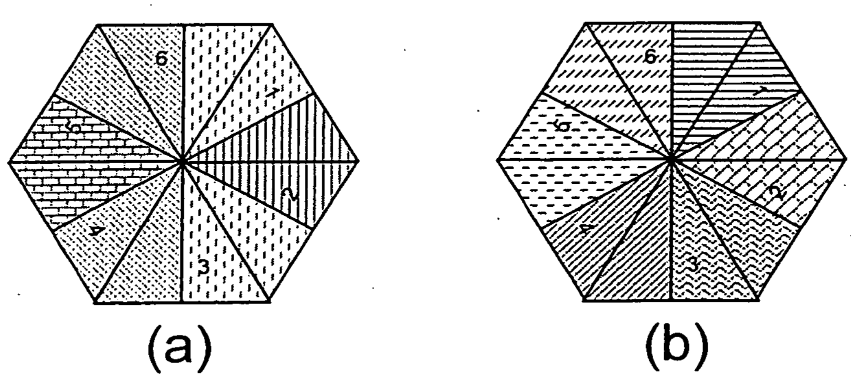

Figure 2

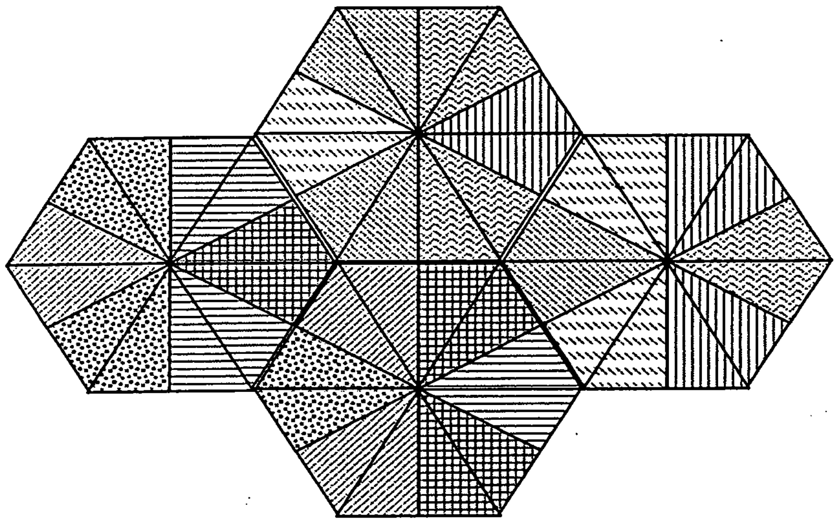

Figure 3

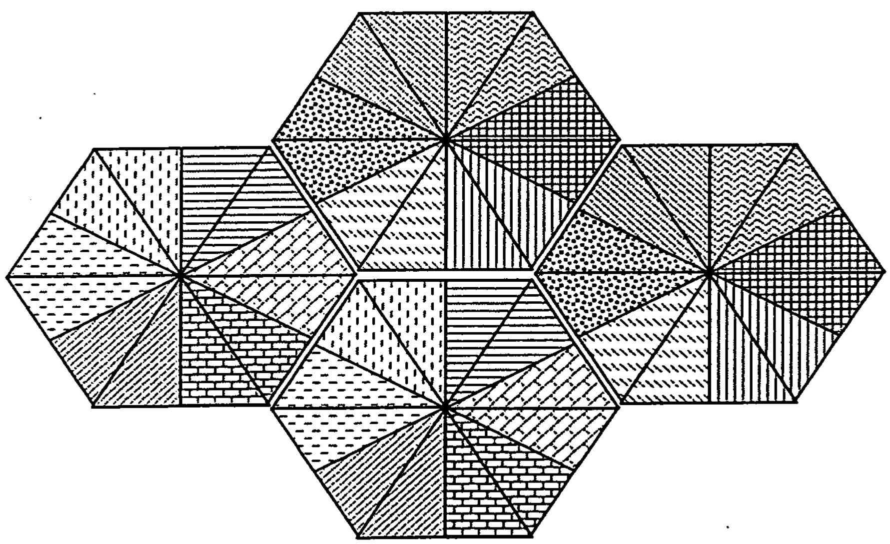

Figure 4

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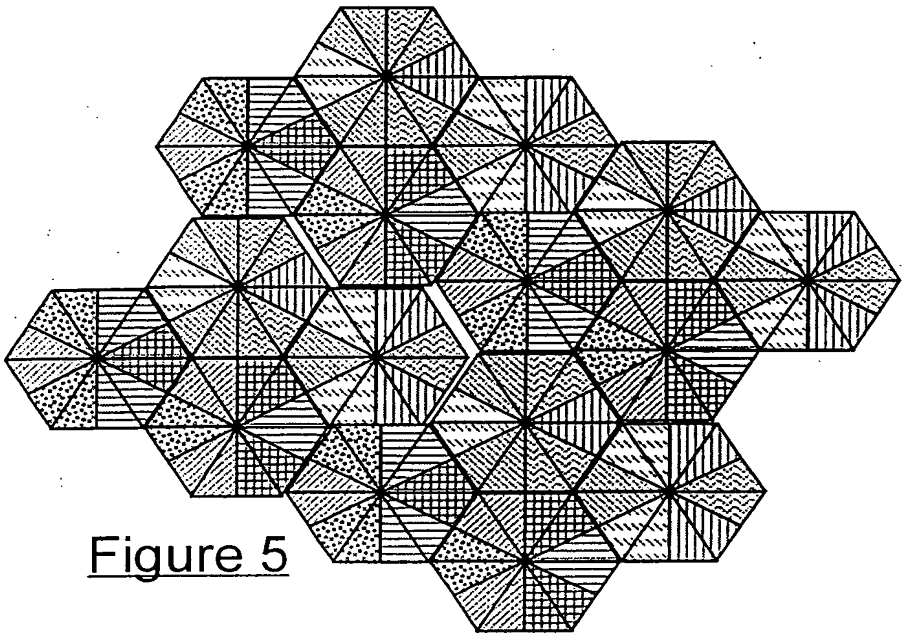

Figure 5

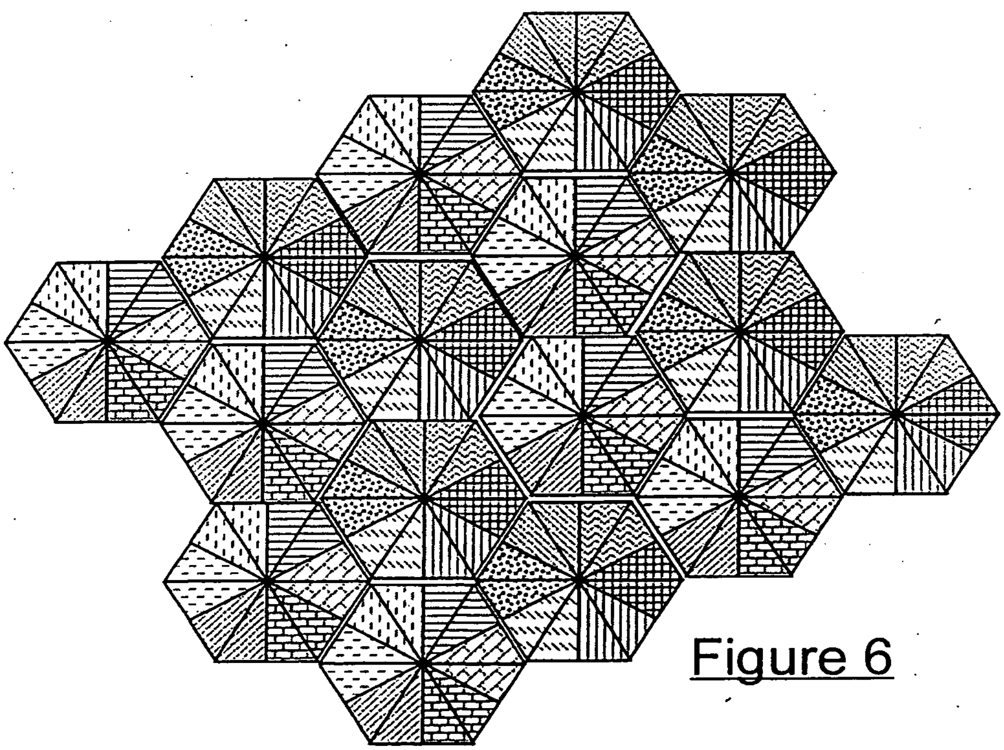

Figure 6

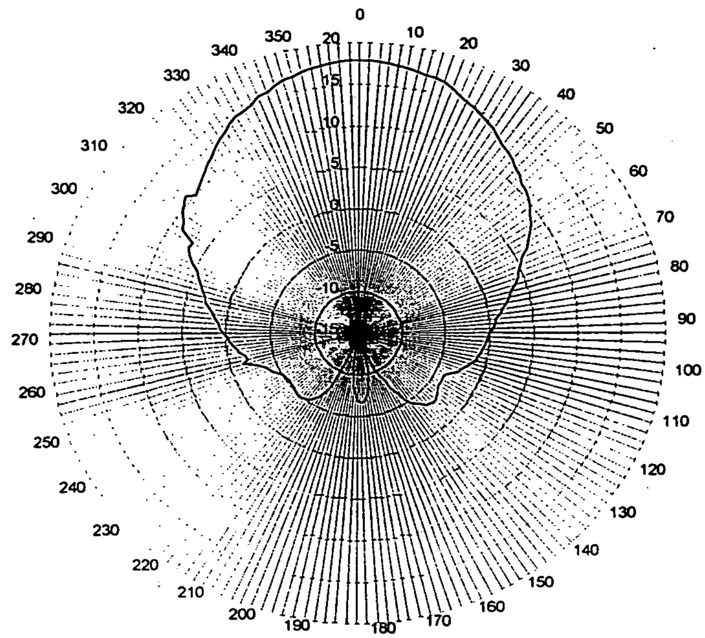

Figure 7

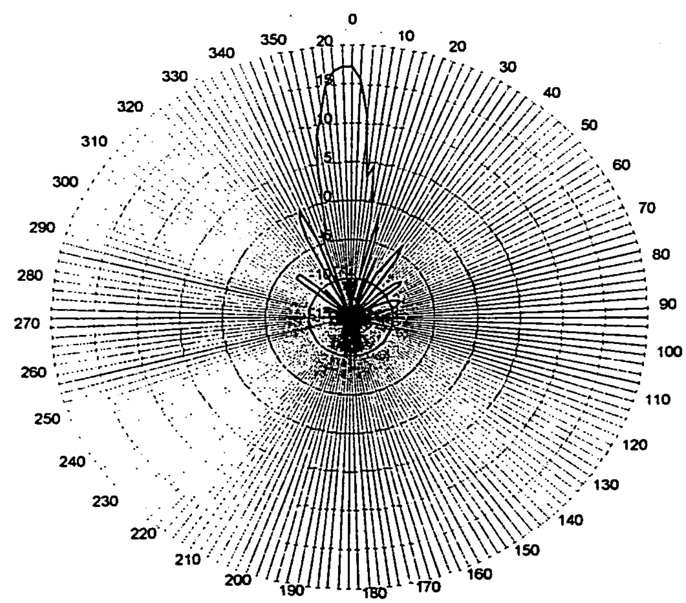

Figure 8